2) Developmental Changes of the Ventricular Electro-phenomena in the Early Stage of Life of WKYs and SHRs. Sadayuki Sato and Tomoe Miyazawa
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With regard to the electrophysiologic study on cardiovascular diseases, particularly ventricular hypertrophy, that occur in the spontaneously hypertensive rat (SHR), including electrocardiographic observation, there have been some studies reported on the heart disorders of 5 to 6 week old rats. However, there have been few studies on younger ones. We have found that there are rapid shortening in the QT-interval of ECG and in the left ventricular transmembrane action potential duration (APD) together with rapid increase in heart rate in the normotensive rats of neonatal to juvenile periods. We were curious if SHRs show a different tendency— in other words, if they have abnormal electrophysiologic phenomena in their ventricles already in their postnatal period. The following experiment has been done in order to discuss this problem:

As for material, each five males of 1, 3, 5, 7, 10 and 15 day old WKYs and SHRs were used. ECG was taken with the lead II electrocardiogram under no anesthesia, connected to cathode ray oscilloscope and photographed. We studied the correlation of RR- and QT-intervals which had been obtained from the average values of 10 heart rates. The epicardial action potential of the left ventricle was recorded by mounting the heart, which had been removed under no anesthesia, placing the left ventricle free wall upside, in a cardiac muscle chamber containing about 35ml. of Tyrode solution equilibrated with a mixture of 95% O₂ and 5% CO₂ and kept 37°C. It was stimulated by a pair of stimulating electrodes with rectangular pulse wave of 4 msec. in duration, of twice the threshold intensity and of 1 cycle per sec. In frequency. the action potentials, conventional micro-electrode method being used, were recorded at 50 to 100 sites of the sample, and the durations of 30%, 50% and 90% of their repolarization phases were measured. We compared the determined values by obtaining their mean values, relative frequency distributions and cumulative frequency distribution curves.

The results showed: 1) The QT-interval of ECG shortened rapidly with SHRs also as they got older (by day). However, the tendency was less conspicuous than WKYs. 2) The correlation of the QT- and the RR-interval was positive with SHRs also. However, it was varied and lower than with WKYs. 3) APD of SHRs tended to be longer than that of WKYs in the neonatal period. And there is a difference between the tow groups in the rate of shortening of APD as they get older (by day). 4) In the length of APD, SHRs showed a wide distribution pattern in the relative frequency distribution and the cumulative frequency distribution curve.

It has been inferred that the tendency of ventricular hypertrophy in SHRs is a cause, rather than a result of hypertension, because it appears after four weeks of age and precedes the onset of hypertension. It seems that this has not been verified electrophysiologically. In this study we have found that, although this is not a direct proof for the onset of ventricular hypertrophy, the QT-interval of SHRs is a little longer than that of WKYs in the neonatal and juvenile periods, and that there is a difference between SHRs and WKYs in the tendency of shortening of the APD of the left ventricular epicardium. More research is necessary to determine if this difference in the ventricular electro-phenomenon in the early stage of life is related to the ECG pattern of ventricular hypertrophy that appears in 5 to 6 weeks of age.

In conclusion, we compared the shortening tendencies of the QT-interval of ECG and the epicardium of the left ventricular action potential in the neonatal to juvenile period of SHRs and WKYs by the days of age. The results showed that SHRs always show a tendency of elongation of the durations and intervals more than WKYs, and that there is a difference between the two groups already in this period.